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Product data representation and exchange: Application module: General Surface Appearance

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ABSTRACT:

This document is a draft of the proposed application module for non-shading surface presentation, including color assignment and wireframe style presentation.

KEYWORDS:

application module, appearance, surface presentation, wireframe presentation, surface color

COMMENTS TO READER:

This is a sample module for the WG10 STEP Modularization PWI.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

International Standard ISO 10303-504 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC4, *Industrial data*.

ISO 10303 consists of the following parts under the general title *Industrial automation systems and integration - Product data representation and exchange*:

Part 1, Overview and fundamental principles;

Part 11, Description methods: The EXPRESS language reference manual;

Part 12, Description method: The EXPRESS-I language reference manual;

Part 21, Implementation methods: Clear text encoding of the exchange structure;

Part 22, Implementation method: Standard data access interface specification;

Part 23, Implementation method: C++ language binding to the standard data access interface;

Part 24, Implementation method: C language binding to the standard data access interface;

Part 26, Implementation method: Interface definition language binding to the standard data access;

Part 31, Conformance testing methodology and framework: General concepts;

Part 32, Conformance testing methodology and framework: Requirements on testing laboratories and clients;

Part 33, Conformance testing methodology and framework: Structure and use of abstract test suites;

Part 34, Conformance testing methodology and framework: Abstract test methods;

Part 35, Conformance testing methodology and framework: Abstract test methods for SDAI

implementations;

Part 41, Integrated generic resources: Fundamentals of product description and support;

Part 42, Integrated generic resources: Geometric and topological representation;

Part 43, Integrated generic resources: Representation structures;

Part 44, Integrated generic resources: Product structure configuration;

Part 45, Integrated generic resource: Materials;

Part 46, Integrated generic resources: Visual presentation;

Part 47, Integrated generic resource: Shape variation tolerances;

Part 49, Integrated generic resource: Process structure and properties;

Part 101, Integrated application resource: Draughting;

Part 104, Integrated application resource: Finite element analysis;

Part 105, Integrated application resource: Kinematics;

Part 106, Integrated application resource: Building construction core model;

Part 201, Application protocol: Explicit draughting;

Part 202, Application protocol: Associative draughting;

Part 203, Application protocol: Configuration controlled design;

Part 204, Application protocol: Mechanical design using boundary representation;

Part 205, Application protocol: Mechanical design using surface representation;

Part 207, Application protocol: Sheet metal die planning and design;

Part 208, Application protocol: Life cycle management - Change process;

Part 209, Application protocol: Composite and metallic structural analysis and related design;

Part 210, Application protocol: Electronic assembly, interconnet, and packaging design;

Part 212, Application protocol: Electrotechnical design and installation;

Part 213, Application protocol: Numerical control process plans for machined parts;

Part 214, Application protocol: Core data for automotive design;

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Part 215, Application protocol: Ship arrangement;

Part 217, Application protocol: Ship piping;

Part 218, Application protocol: Ship structures;

products;

Part 222, Application protocol: Exchange of product data for composite structures;

Part 223, Application protocol: Exchange of design and manufacturing product information for casting parts;

Part 224, Application protocol: Mechanical product definition for process plans using machining features;

Part 225, Application protocol: Building elements using explicit shape representation;

Part 227, Application protocol: Plant spatial configuration;

Part 228, Application protocol: Building services: Heating, ventilation, and air conditioning;

forged parts;

Part 231, Application protocol: Process engineering data: Process design and process specification of

Part 232, Application protocol: Technical data packaging core information and exchange;

Part 301, Abstract test suite: Explicit draughting;

Part 303, Abstract test suite: Configuration controlled design;

Part 304, Abstract test suite: Mechanical design using boundary representation;

Part 305, Abstract test suite: Mechanical design using surface representation;

Part 307, Abstract test suite: Sheet metal die planning and design;

Part 308, Abstract test suite: Life cycle management - Change process;

Part 309, Abstract test suite: Composite and metallic structural analysis and related design;

Part 310, Abstract test suite: Electronic assembly, interconnect, and packaging design;

Part 312, Abstract test suite: Electrotechnical design and installation;

Part 313, Abstract test suite: Numerical control process plans for machined parts;

Part 314, Abstract test suite: Core data for automotive mechanical design;

Part 315, Abstract test suite: Ship arrangement;

Part 316, Abstract test suite: Ship moulded forms;

Part 317, Abstract test suite: Ship piping;

Part 318, Abstract test suite: Ship structures;

Part 320, Abstract test suite: Process planning, manufacture, and assembly of layered electronic products;

Part 321, Abstract test suite: Functional data and their schematic representation for process plant;

Part 322, Abstract test suite: Exchange of product data for composite structures;

Part 323, Abstract test suite: Exchange of design and manufacturing product information for casting parts;

Part 324, Abstract test suite: Mechanical product definition for process plans using machining features;

Part 325, Abstract test suite: Building elements using explicit shape representation;

Part 326, Abstract test suite: Ship mechanical systems;

Part 327, Abstract test suite: Plant spatial configuration;

Part 328, Abstract test suite: Building services: Heating, ventilation, and air conditioning;

parts;

Part 331, Abstract test suite: Process engineering data: Process design and process specification of

Part 332, Abstract test suite: Technical data packaging core information and exchange;

Part 501, Application interpreted construct: Edge-based wireframe;

Part 503, Application interpreted construct: Geometrically bounded 2D wireframe;

Part 504, Application interpreted construct: Draughting annotation;

Part 506, Application interpreted construct: Draughting elements;

Part 507, Application interpreted construct: Geometrically bounded surface;

Part 509, Application interpreted construct: Manifold surface;

Part 510, Application interpreted construct: Geometrically bounded wireframe;

Part 512, Application interpreted construct: Faceted boundary representation;

Part 513, Application interpreted construct: Elementary boundary representation;

Part 515, Application interpreted construct: Constructive solid geometry;

Part 517, Application interpreted construct: Mechanical design geometric presentation;

The structure of this International Standard is described in ISO 10303-1. The numbering of the parts of the

Parts 11 to 13 specify the description methods;

Parts 21 to 26 specify the implementation methods;

Parts 31 to 35 specify the conformance testing methodology and framework;

Parts 41 to 49 specify the integrated generic resources;

Parts 101 to 106 specify the integrated application resources;

Parts 201 to 232 specify the application protocols;

Parts 301 to 332 specify the abstract test suites;

Parts 501 to 518 specify the application interpreted constructs;

Should further parts be published, they will follow the same numbering pattern.

Annexes A, B, and C form an integral part of this part of ISO 10303. Annexes D, E, F, G, and H are for information only

Introduction

product data. The objective is to provide a neutral mechanism capable of describing product data description makes it suitable not only for neutral file exchange, but also as a basis for implementing and

This International Standard is organized as a series of parts, each published separately. The parts of ISO interpreted constructs, application protocols, application modules, abstract test suites, implementation -1. This part of ISO 10303 is a

This part of ISO 10303 specifies an application module for non-shading surface presentation, including

Product data representation and exchange

Part 6XX: Application module: General surface appearance

1 Scope

This part of ISO 10303 specifies the application module for non-shaded surface presentation, encompassing color assignment and wireframe-style visual attributes.

The following are within scope of this part of ISO 10303:

- assignment of visual attributes to curves belonging to surfaces;
- selection of specific curve types for wireframe-like presentation of surfaces;
- assignment of color to surfaces.

The following are outside the scope of this part of ISO 10303:

- realistic presentation of surfaces;
- scientific visualization.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC 8824-1:1994, Information technology Open systems interconnection Abstract syntax notation one (ASN.1) Part 1: Specification of basic notation.

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ISO 10303-1:1994, Industrial automation systems and integration Product data representation and exchange Part 1: Overview and fundamental principles.

ISO 10303-11:1994, Industrial automation systems and integration Product data representation and exchange Part 11: Description methods: The EXPRESS language reference manual.

ISO/CD 10303-41¹, Industrial automation systems and integration Product data representation and exchange Part 41: Integrated generic resource: Fundamentals of product description and support.

3 Terms, definitions and abbreviations

3.1 Terms defined in ISO 10303-1

For the purpose of this part of ISO 10303, the following terms defined in ISO 10303-1 apply.

application;

application protocol;

data;

information;

integrated resource;

product;

product data.

3.2 Abbreviations

For the purposes of this part of ISO 10303, the following abbreviations apply.

MIM module interpreted model

4 Information requirements

This clause specifies the information requirements for general surface appearance.

¹ To be published.

2

The information requirements are specified as a set of units of functionality, application elements, and application assertions. These assertions pertain to individual application entities and to relationships between application entities. The information requirements are defined using the terminology of the subject area of this application module.

A graphical representation of the information requirements is given in annex C.

The mapping table is specified in 5.1 which shows how the information requirements are met using the integrated resources of this International Standard. The use of the integrated resources introduces additional requirements which are common to application modules and protocols.

EXPRESS specification:

```
* )  
SCHEMA general_surface_appearance_arm;  
(*
```

4.1 Units of Functionality

This subclause specifies the units of functionality for the general surface appearance module. This module specifies the following unit of functionality:

general_surface_appearance;

This module uses the following units of functionality:

colour;

curve_appearance;

4.1.1 General_surface_appearance

The general_surface_appearance UoF specifies application objects for presentation of surfaces using wireframe-style attributes and surface colour.

The following application objects are specified in the general_surface_appearance UoF:

boundary_curve_appearance;

control_grid_appearance;

parameter_line_appearance;

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```
segmentation_curve_appearance;  
silhouette_curve_appearance;  
surface_appearance_wireframe;  
surface_colour;  
surface_related_curve_appearance.
```

4.1.2 Colour

This UoF is defined in the colour module. The following application entities from this UoF are referenced in the general surface appearance module:

```
colour.
```

4.1.3 Curve_appearance

This UoF is defined in the curve_appearance module. The following application entities from this UoF are referenced in the general surface appearance module:

```
curve_appearance.
```

4.2 Referenced AM ARMs

```
* )  
USE FROM curve_appearance_arm;  
USE FROM colour_arm;  
(*
```

4.3 ARM entity definitions

This subclause specifies the application objects for the general surface appearance module. Each application object is an atomic element that embodies a unique application concept and contains attributes specifying the data elements of the object.

4.3.1 boundary_curve_appearance

A **boundary_curve_appearance** is the curve style that is applied to the boundary curves of a surface.

EXPRESS specification:

```

*)  

ENTITY boundary_curve_appearance  

SUBTYPE OF (surface_related_curve_appearance);  

END_ENTITY;  

(*

```

4.3.2 control_grid_appearance

A **control_grid_appearance** is the curve style that is applied to the mesh of control points which are used for the definition of surfaces.

EXPRESS specification:

```

*)  

ENTITY control_grid_appearance  

SUBTYPE OF (surface_related_curve_appearance);  

END_ENTITY;  

(*

```

4.3.3 parameter_line_appearance

A parameter_line_appearance is the curve style that is applied to the iso-parameter lines on a surface.

EXPRESS specification:

```

*)  

ENTITY parameter_line_appearance  

SUBTYPE OF (surface_related_curve_appearance);  

number_of_u_curves:INTEGER;  

number_of_v_curves:INTEGER;  

END_ENTITY;  

(*

```

Attribute definitions:

number_of_u_curves: specifies the number of iso-parameter lines to be presented in the u direction.

number_of_v_curves: specifies the number of iso-parameter lines to be presented in the v direction.

4.3.4 segmentation_curve_appearance

A **segmentation_curve_appearance** is the curve style that is applied to the curves on the segment borders of a surface.

EXPRESS specification:

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```
* )
ENTITY segmentation_curve_appearance
  SUBTYPE OF (surface_related_curve_appearance);
END_ENTITY;
(*
```

4.3.5 silhouette_curve_appearance

A **silhouette_curve_appearance** is the curve style that is applied to the silhouette curves of a surface.

EXPRESS specification:

```
* )
ENTITY silhouette_curve_appearance
  SUBTYPE OF (surface_related_curve_appearance);
END_ENTITY;
(*)
```

4.3.6 surface_appearance_wireframe

A **surface_appearance_wireframe** specifies visual attributes for the wireframe-like presentation of a surface.

EXPRESS specification:

```
* )
ENTITY surface_appearance_wireframe;
  side          : STRING;
  styles        : SET [1:5] OF surface_related_curve_appearance;
END_ENTITY;
(*)
```

Attribute definitions:

side: specifies the side of a surface to which the styles are applied.

styles: the curve styles used for the wireframe-like surface presentation.

4.3.7 surface_colour

A **surface_colour** specifies the colour for non-shading presentation of a surface.

EXPRESS specification:

```
* )
ENTITY surface_colour;
  side          : STRING;
```

```
    assigned_colour: colour;
END_ENTITY;
(*
```

Attribute definitions:

side: specifies the side of a surface to which colour is applied.

assigned_colour: the colour used for non-shading surface presentation.

4.3.8 surface_related_curve_appearance

A **surface_related_curve_appearance** is a generalization of the styles assigned to curves for wireframe-like surface presentation.

EXPRESS specification:

```
*)  
ENTITY surface_related_curve_appearance  
ABSTRACT SUPERTYPE OF (ONEOF(boundary_curve_appearance,  
silhouette_curve_appearance, segmentation_curve_appearance,  
control_grid_appearance, parameter_line_appearance));  
    style : curve_appearance;  
END_ENTITY;  
(*
```

Attribute definitions:

style: specifies the curve appearance associated with each curve type in the context of wireframe-like surface presentation

```
*)  
END_SCHEMA; -- general_surface_appearance_arm  
(*
```

5 Module Interpreted Model**5.1 Mapping Table**

This clause contains the mapping table that shows how each UoF and application entity of this part of ISO 10303 maps to one or several MIM resource constructs. The mapping table is organized in five columns. The contents of these five columns are:

Column 1) Application element: Name of an application element as it appears in the application object definition in 4.2. Application object names are written in uppercase. Attribute names are listed after the

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application object to which they belong and are written in lower case.

Column 2) MIM element: Name of an MIM element as it appears in the MIM, the term `IDENTICAL MAPPING', or the term `PATH'. MIM entities are written in lower case. Attribute names of MIM entities are referred to as <entity name>.<attribute name>. The mapping of an application element may result in several related MIM elements. Each of these MIM elements requires a line of its own in the table. The term `IDENTICAL MAPPING' indicates that both application objects of an application assertion map to the same MIM element. The term `PATH' indicates that the application assertion maps to the entire reference path.

Column 3) Source: For those MIM elements that are interpreted from the integrated resources, this is the number of the corresponding part of ISO 10303.

Column 4) Rules: One or more numbers may be given that refer to rules that apply to the current MIM element or reference path. For rules that are derived from relationships between application objects, the same rule is referred to by the mapping entries of all the involved MIM elements. The expanded names of the rules are listed after the table.

Column 5) Reference path: To describe fully the mapping of an application object, it may be necessary to specify a reference path through several related MIM elements. The reference path column documents the role of an MIM element relative to the MIM element in the row succeeding it. Two or more such related MIM elements define the interpretation of the integrated resources that satisfies the requirement specified by the application object. For each MIM element that has been created for use within this part of ISO 10303, a reference path up to its supertype from an integrated resource is specified.

For the expression of reference paths and the relationships between MIM elements the following notational conventions apply:

- a) [] : multiple MIM elements or sections of the reference path are required to satisfy an information requirement;
- b) () : multiple MIM elements or sections of the reference path are identified as alternatives within the mapping to satisfy an information requirement;
- c) {} : enclosed section constrains the reference path to satisfy an information requirement;
- d) -> : attribute references the entity or select type given in the following row;
- e) <- : entity or select type is referenced by the attribute in the following row;
- f) [i] : attribute is an aggregation of which a single member is given in the following row;

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- g) [n] : attribute is an aggregation of which member n is given in the following row;
- h) => : entity is a supertype of the entity given in the following row;
- i) <= : entity is a subtype of the entity given in the following row;
- j) = : the string, select, or enumeration type is constrained to a choice or value;
- k) \ : the line continuation for strings that wrap.

Table 1 - Mapping table for general_surface_appearance module

Application element	AIM element	Source	Rules	Reference path
BOUNDARY_CURVE_APPEARANCE	surface_style_boundary	46		
CONTROL_GRID_APPEARANCE	surface_style_control_grid	46		
PARAMETER_LINE_APPEARANCE	surface_style_parameter_line	46		
number_of_u_curves	u_direction_count	46		surface_style_parameter_line surface_style_parameter_line.direction_counts[1] -> direction_count_select direction_count_select = u_direction_count u_direction_count
number_of_v_curves	v_direction_count			surface_style_parameter_line surface_style_parameter_line.direction_counts[1] -> direction_count_select direction_count_select = v_direction_count v_direction_count
SEGMENTATION_CURVE_APPEARANCE	surface_style_segmentation_curve	46		
SILHOUETTE_CURVE_APPEARANCE	surface_style_silhouette	46		
SURFACE_APPEARANCE_WIREFRAME	surface_style_usage	46		
side	surface_side	46		surface_style_usage surface_style_usage.side -> surface_side
styles	PATH			surface_style_usage surface_style_usage.style -> surface_side_style_select

Application element	AIM element	Source	Rules	Reference path
				surface_side_style_select = surface_side_style surface_side_style surface_side_style.styles[i] -> surface_style_element_select
SURFACE_COLOUR	surface_style_usage			
side	surface_side			
assigned_colour				surface_style_usage surface_style_usage.style -> surface_side_style_select surface_side_style_select = surface_side_style surface_side_style surface_side_style.styles[i] -> surface_style_element_select surface_style_elelment_select=surface_style_fill_area surface_style_fill_area.fill_area-> fill_area_style fill_area_style.fill_styles[i]-> fill_style_select fill_style_select=fill_area_style.colour fill_area_style.colour.fill.colour-> colour
SURFACE RELATED _ CURVE_APPEARANCE	surface_style_element_ select	46		
style	PATH			surface_style_element_select (surface_style_element_select=surface_style_parameter_line surface_style_parameter_line surface_style_parameter_line.style_of_parameter_lines -> curve_or_render curve_or_render = curve_style curve_style) (surface_style_element_select=surface_style_silhouette surface_style_silhouette surface_style_silhouette.style_of_silhouette ->

Application element	AIM element	Source	Rules	Reference path
				<pre> curve_or_render curve_or_render = curve_style curve_style) (surface_style_element_select=surface_style_control_grid surface_style_control_grid surface_style_control_grid.style_of_control_grid -> curve_or_render curve_or_render = curve_style curve_style) (surface_style_element_select=surface_style_boundary surface_style_boundary surface_style_boundary.style_of_boundary -> curve_or_render curve_or_render = curve_style curve_style) (surface_style_element_select=surface_style_segmentation_curve surface_style_segmentation_curve surface_style_segmentation_curve.style_of_segmentation_curve-> curve_or_render curve_or_render = curve_style curve_style) </pre>

5.2 Module EXPRESS short listing

This subclause specifies the EXPRESS schema that uses elements from the integrated resources or application interpreted constructs and contains the types, entity specializations, rules, and functions that are specific to this part of ISO 10303. This clause also specifies modifications to the textual material for constructs that are imported from the integrated resources. The definitions and EXPRESS provided in the integrated resources or application interpreted constructs for constructs used in the MIM may include select list items and subtypes which are not imported into the MIM. Requirements stated in the integrated resources or application interpreted constructs which refer to such items and subtypes apply exclusively to those items which are imported into the MIM.

EXPRESS specification:

```

*) SCHEMA general_surface_appearance_mim;
USE FROM curve_appearance_mim;          -- curve appearance module
USE FROM colour_mim;                   -- colour module
USE FROM presentation_appearance_schema -- ISO 10303-46
( fill_area_style_colour,
  surface_side_style,
  surface_style_boundary,
  surface_style_control_grid,
  surface_style_fill_area,
  surface_style_parameter_line,
  surface_style_segmentation_curve,
  surface_style_silhouette,
  surface_style_usage,
  u_direction_count,
  v_direction_count);
(*

```

NOTE — The schema referenced above can be found in the following part of ISO 10303:

curve_appearance_mim	ISO 10303-6XX
colour_mim	ISO 10303-6XX

presentation_appearance_schema	ISO 10303-46
--------------------------------	--------------

```

*) END_SCHEMA;
(*

```

Annex A

(normative)

AM MIM short names

Table A.1 provides the short names of entities specified in this part of ISO 10303. Requirements on the use of the short names are found in the implementation methods included in ISO 10303.

Table A.1 - AM MIM short names

Entity Names	Short Names

Annex B

(normative)

Information object registration

B.1 Document identification

In order to provide for unambiguous identification of an information object in an open system, the object identifier

{ iso standard 10303 part(6XX) version() }

is assigned to this part of ISO 10303. The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

B.2 Schema identification

ISO 10303-1 further describes how ISO/IEC 8824-1 can be used to identify individual schemas. This part of ISO 10303 contains two such schemas, and each is assigned a unique object identifier to provide for unambiguous identification of the schema in an open information system.

In order to provide for unambiguous identification of the general_surface_appearance schema in an open information system, the object identifier

{ iso standard 10303 part(6??) version() object(1) general_surface_appearance -schema(1) }

is assigned to the general_surface_appearance schema (see clause 5.2). The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

Annex C

(informative)

ARM EXPRESS-G

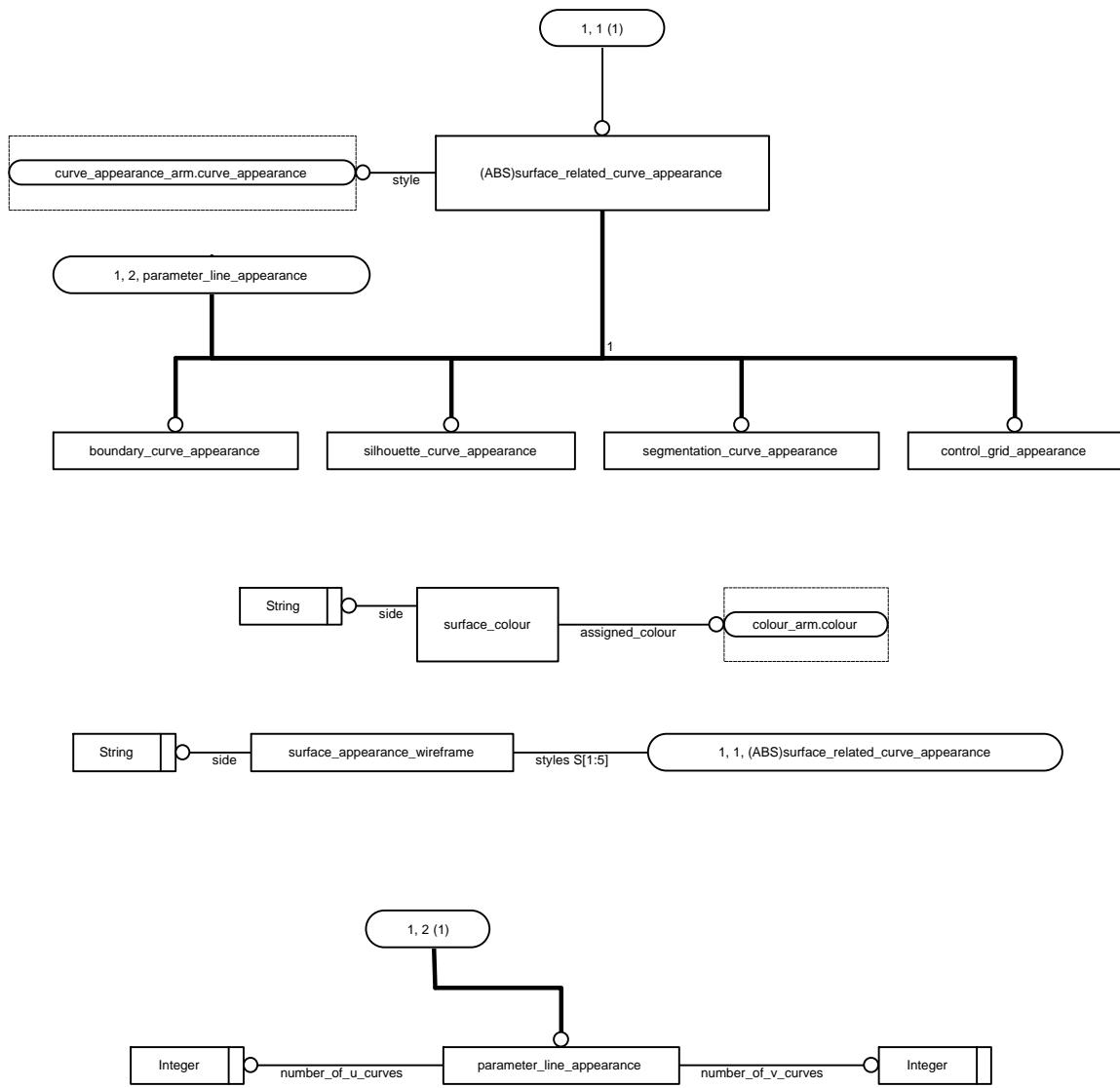


Figure C.1 - ARM EXPRESS-G diagram 1 of 1

Annex D

(informative)

MIM EXPRESS-G

The following diagrams correspond to the MIM EXPRESS given in Clause 5.2. The diagrams use the EXPRESS-G graphical notation for the EXPRESS language. EXPRESS-G is defined in annex A of ISO 10303-11. Note that the inter-page referencing is to the diagram number and not the figure number.

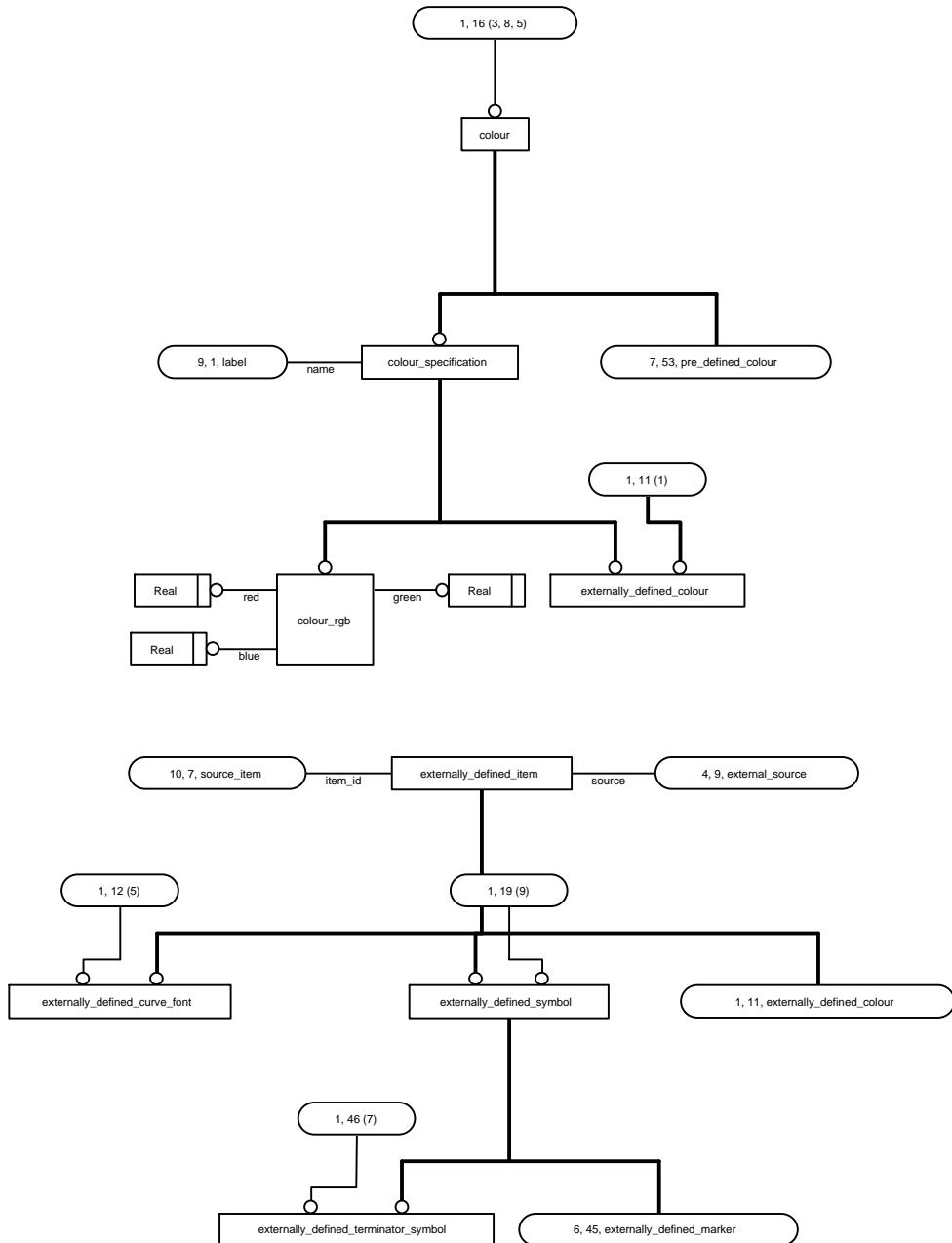


Figure D.1 - MIM EXPRESS-G Diagram 1 of 11

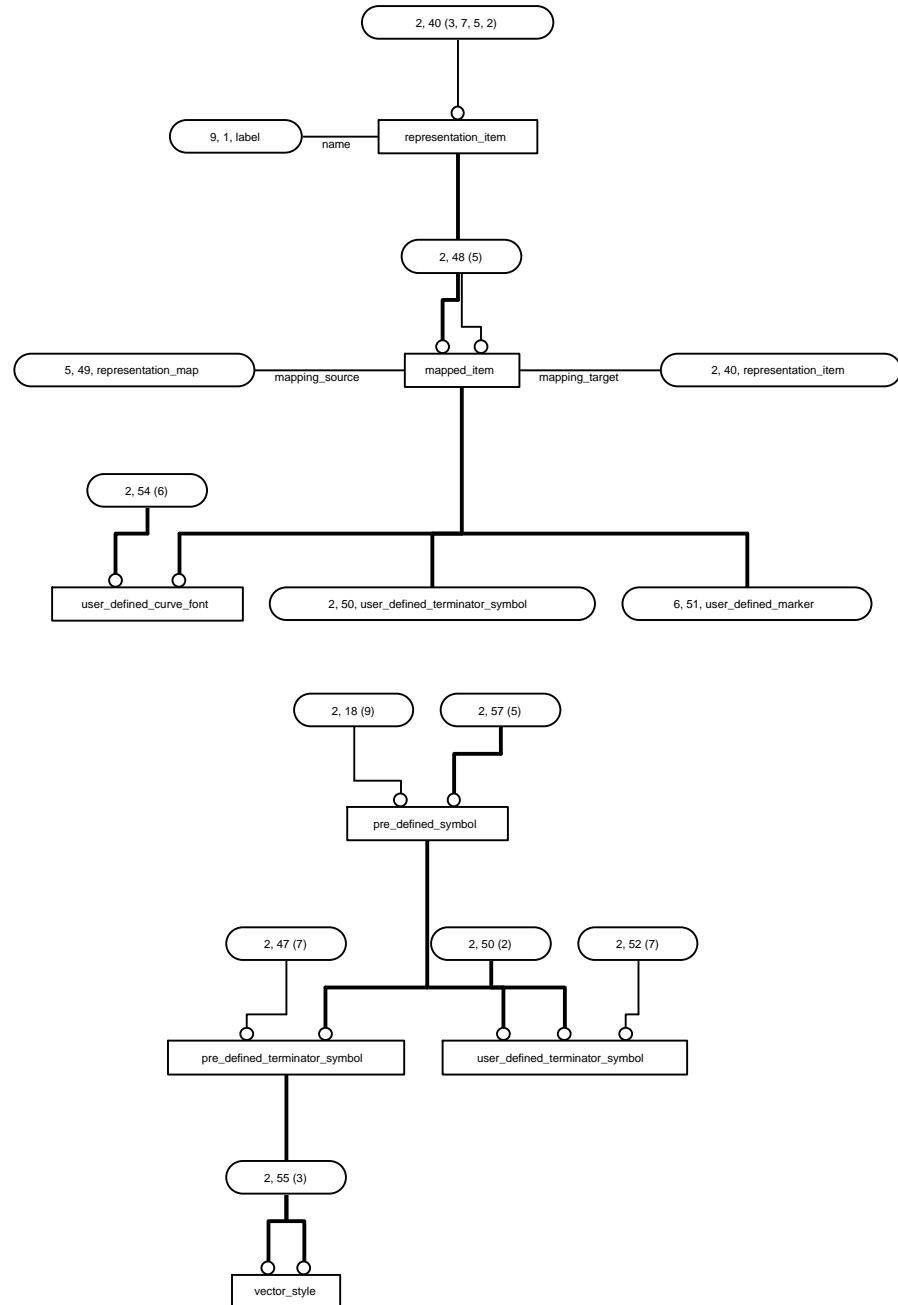


Figure D.2 - MIM EXPRESS-G Diagram 2 of 11

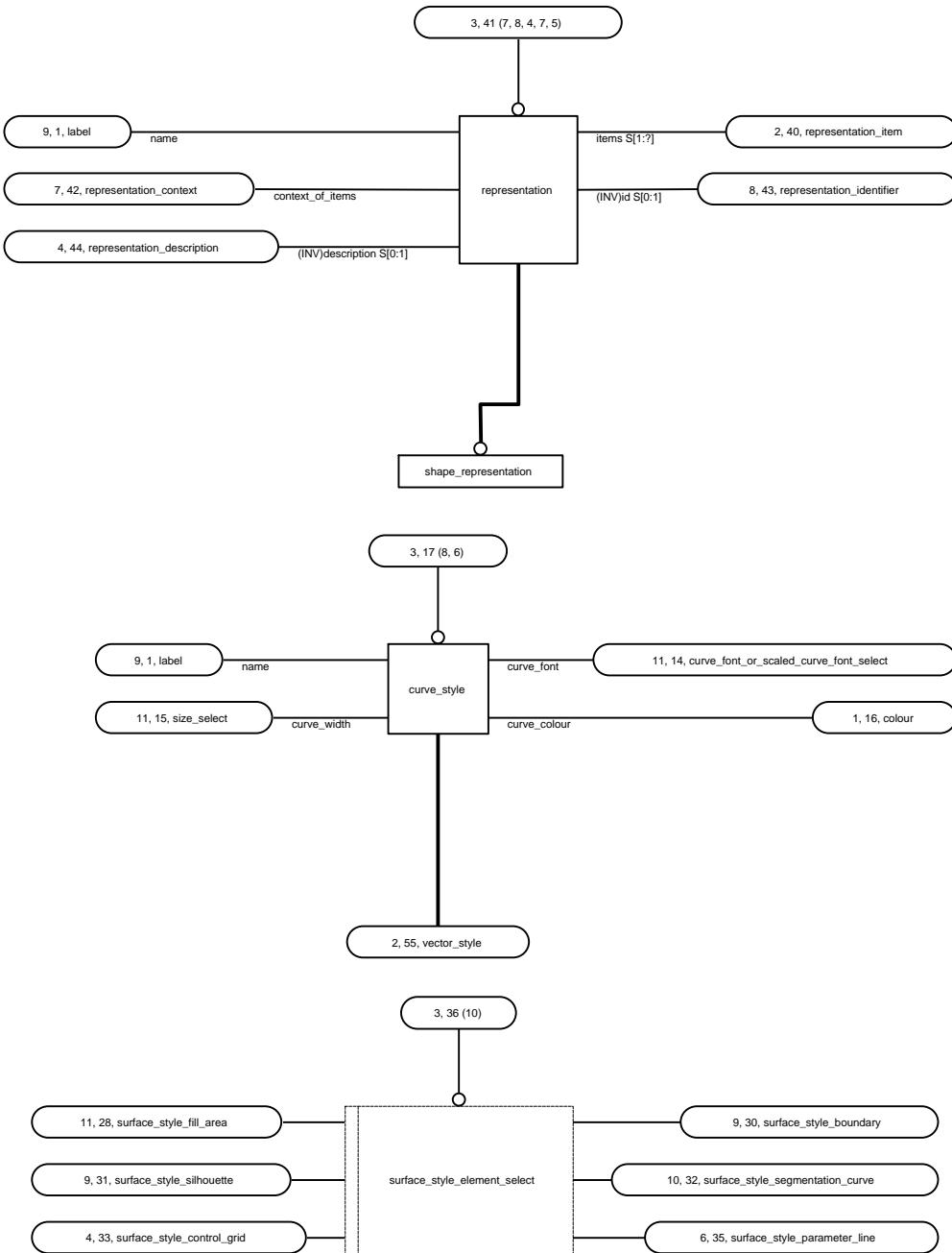


Figure D.3 - MIM EXPRESS-G Diagram 3 of 11

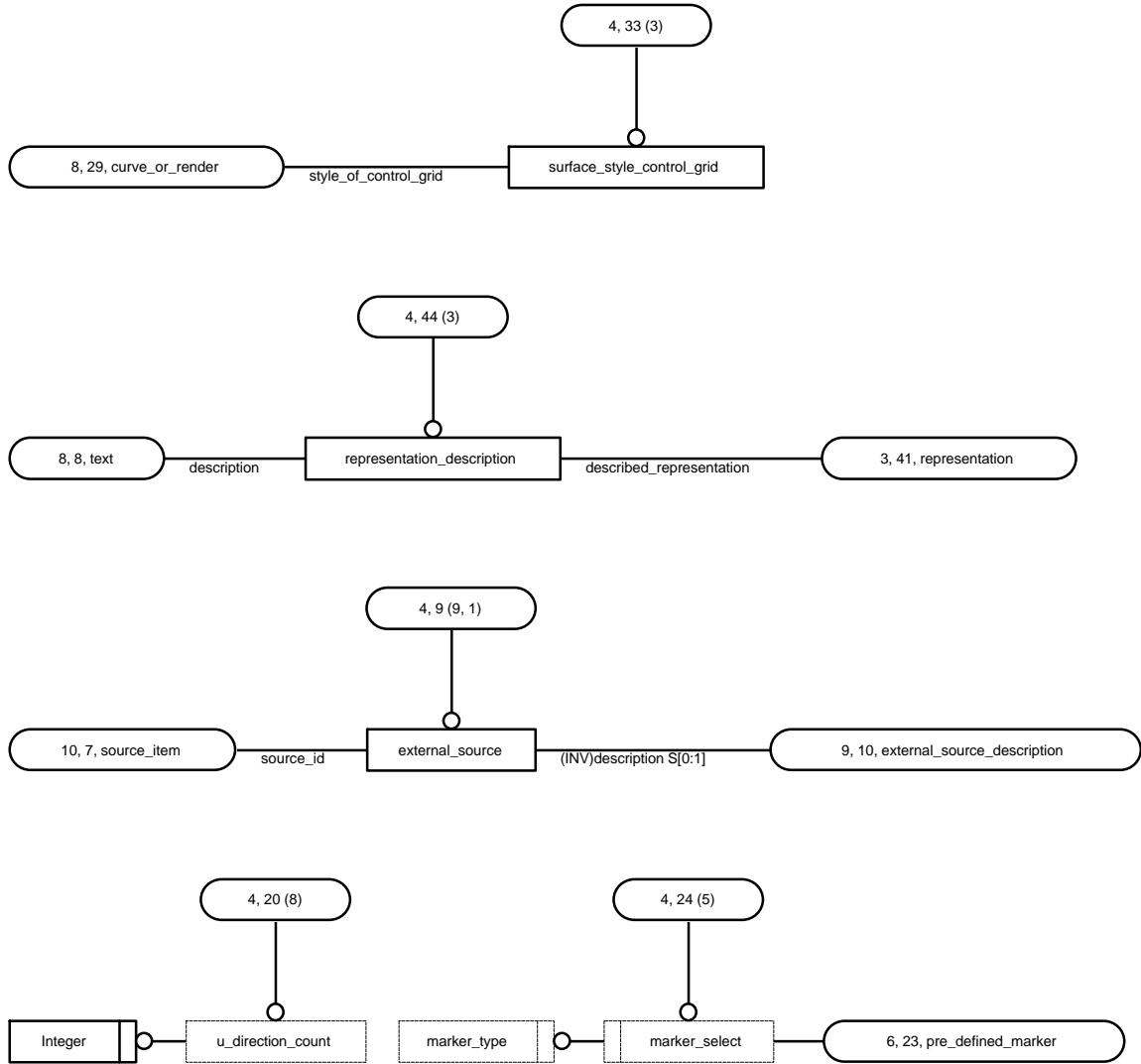
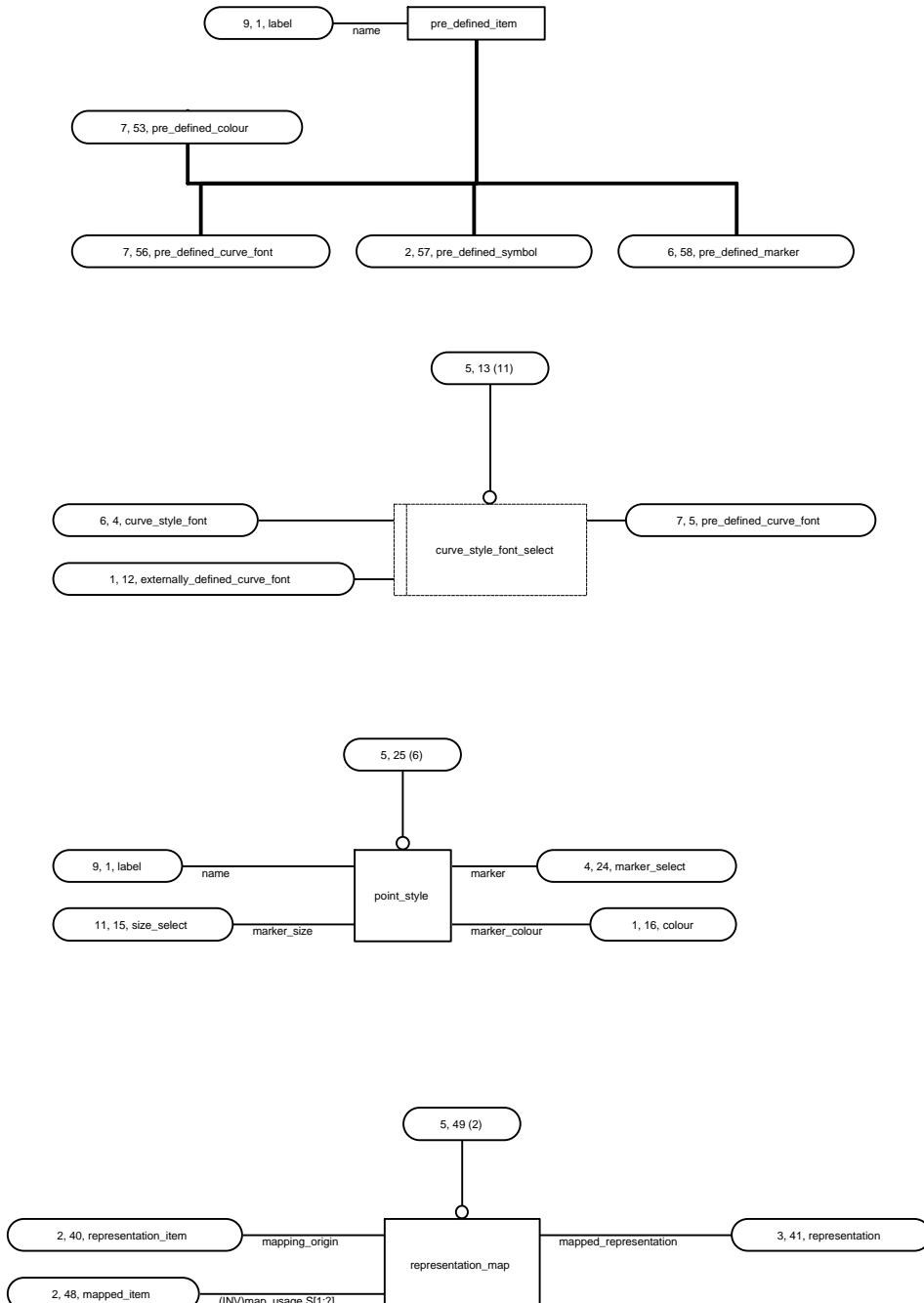


Figure D.4 - MIM EXPRESS-G Diagram 4 of 11



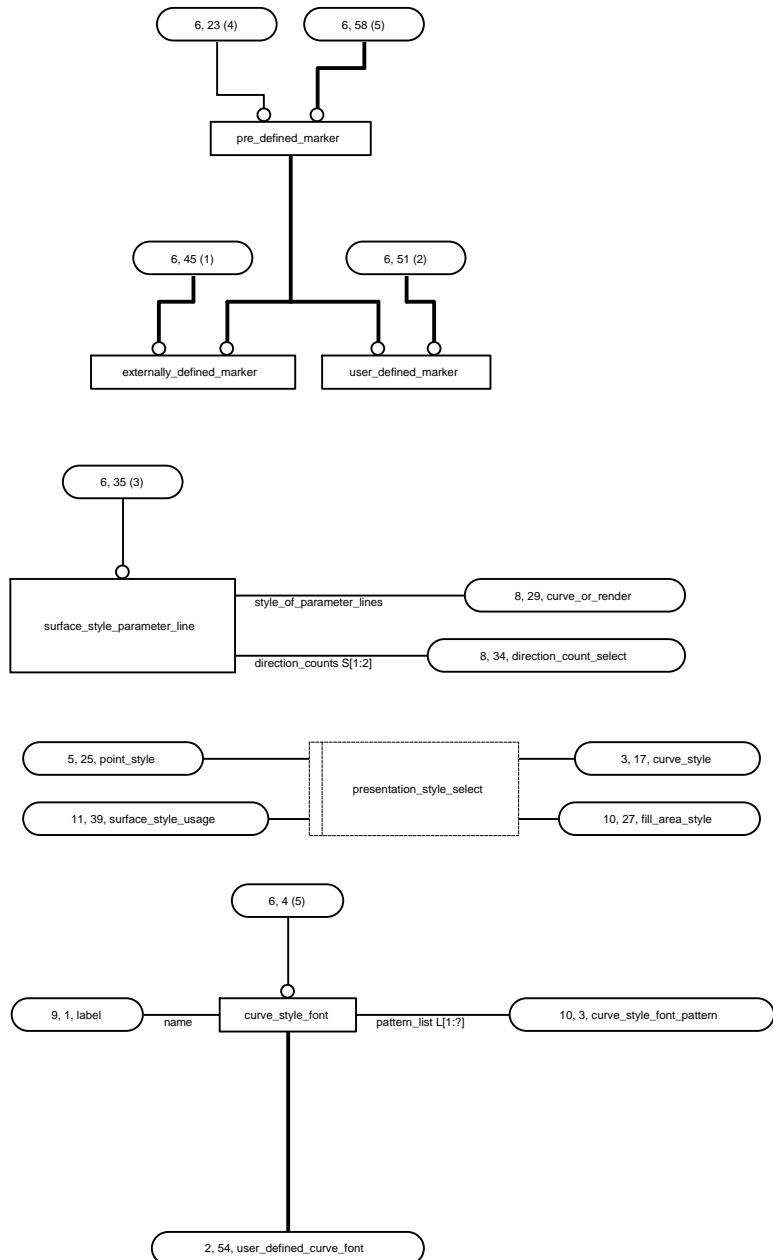


Figure D.6 - MIM EXPRESS-G Diagram 6 of 11

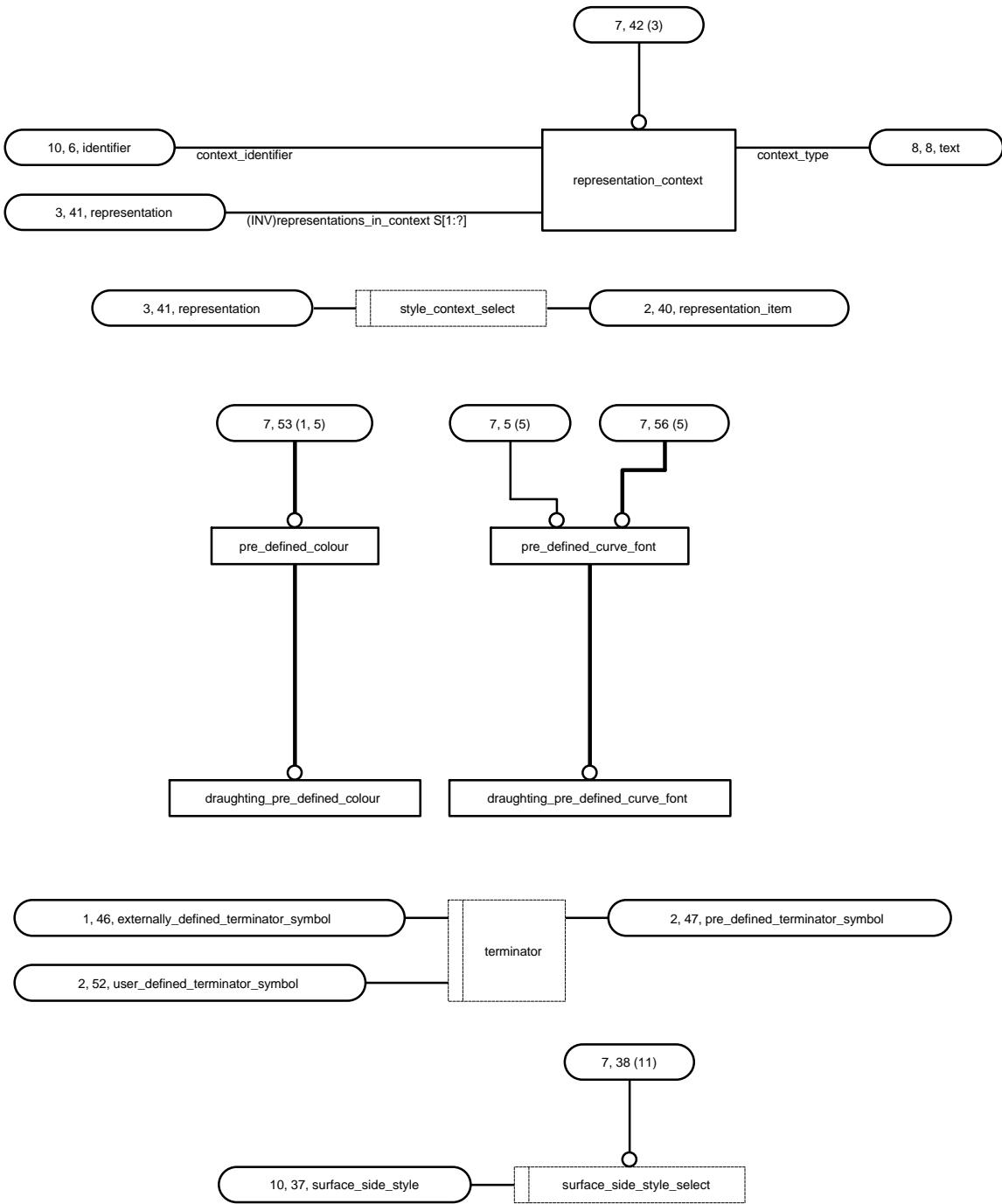


Figure D.7 - MIM EXPRESS-G Diagram 7 of 11

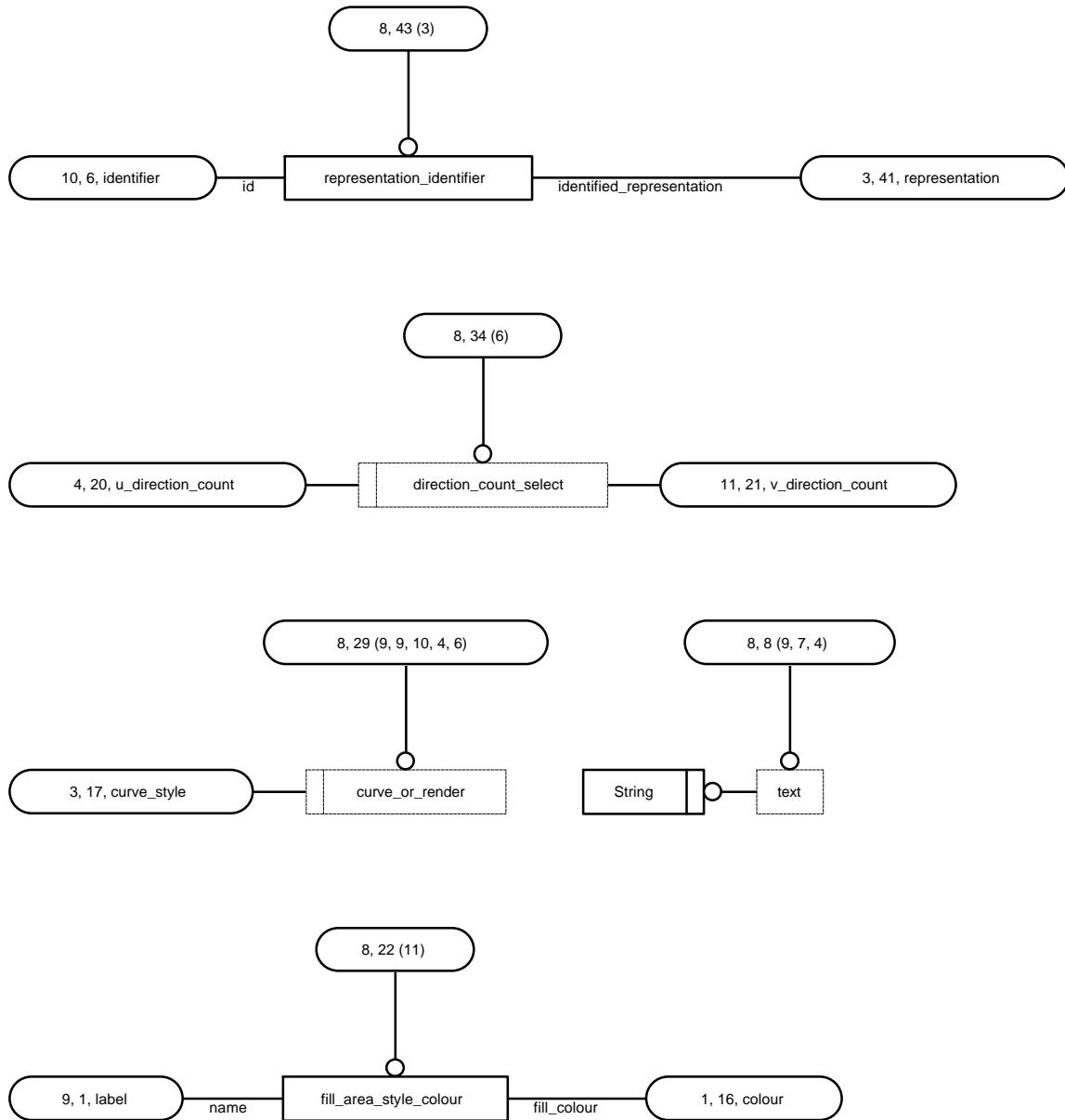


Figure D.8 - MIM EXPRESS-G Diagram 8 of 11

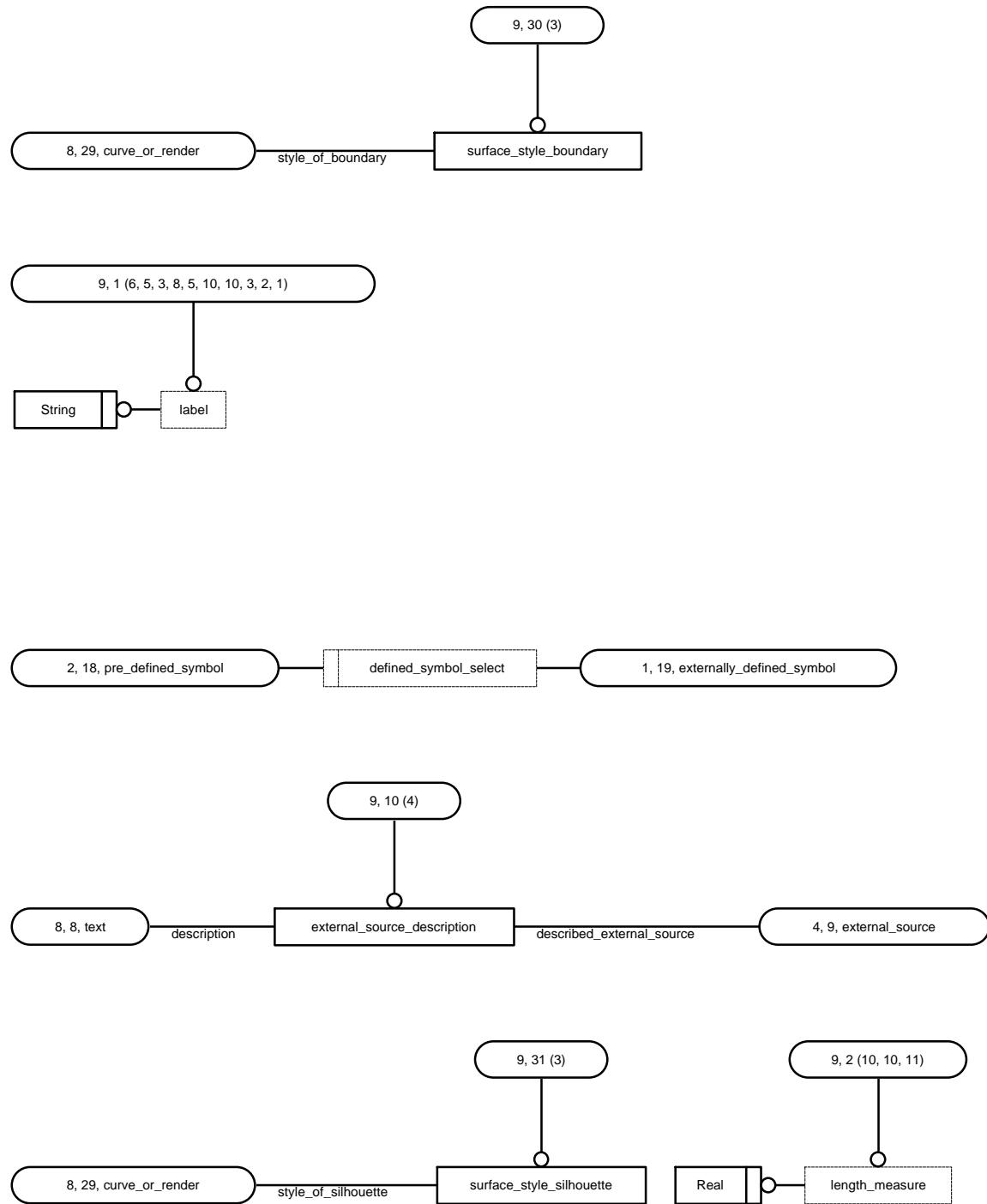


Figure D.9 - MIM EXPRESS-G Diagram 9 of 11

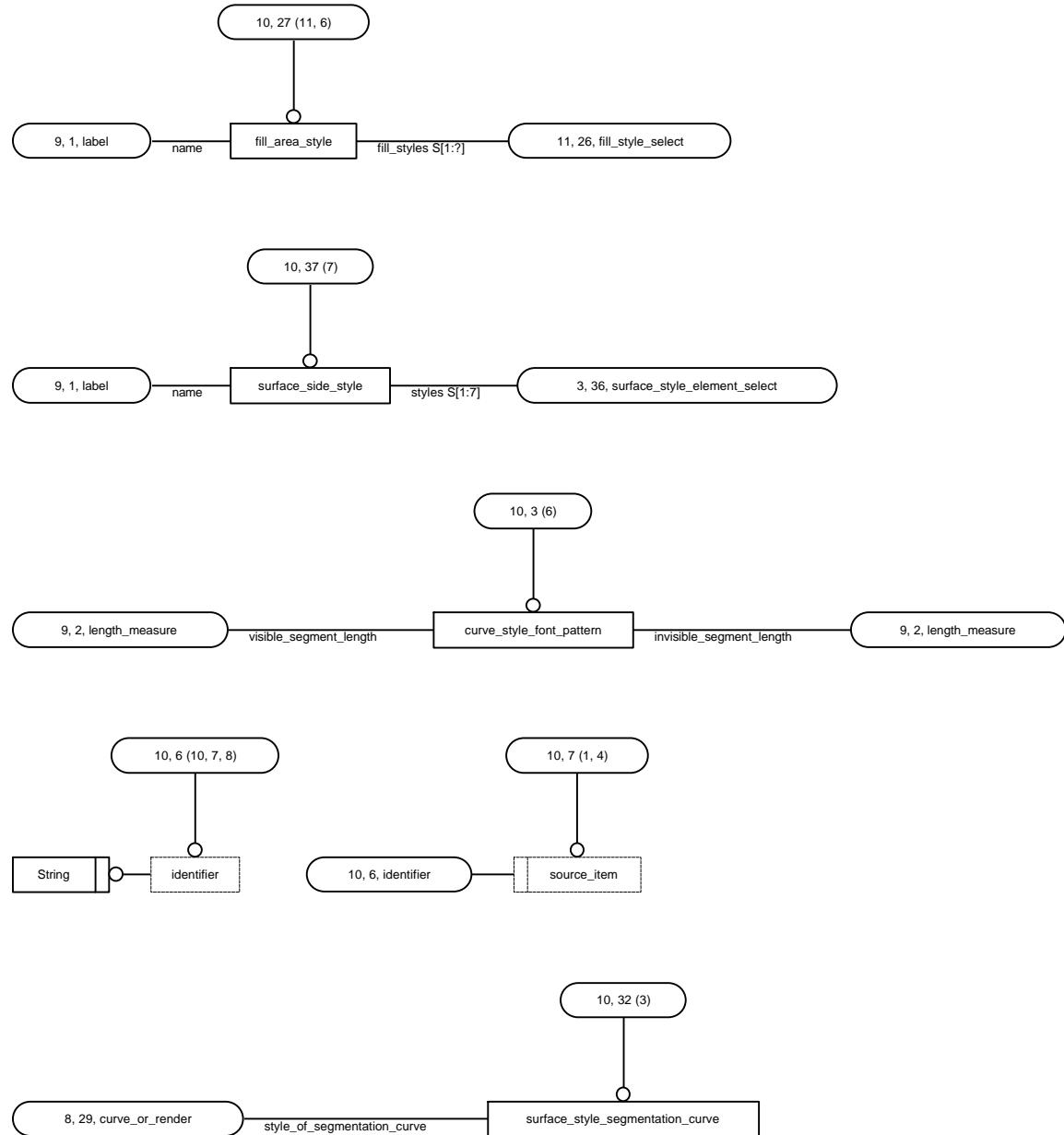


Figure D.10 - MIM EXPRESS-G Diagram 10 of 11

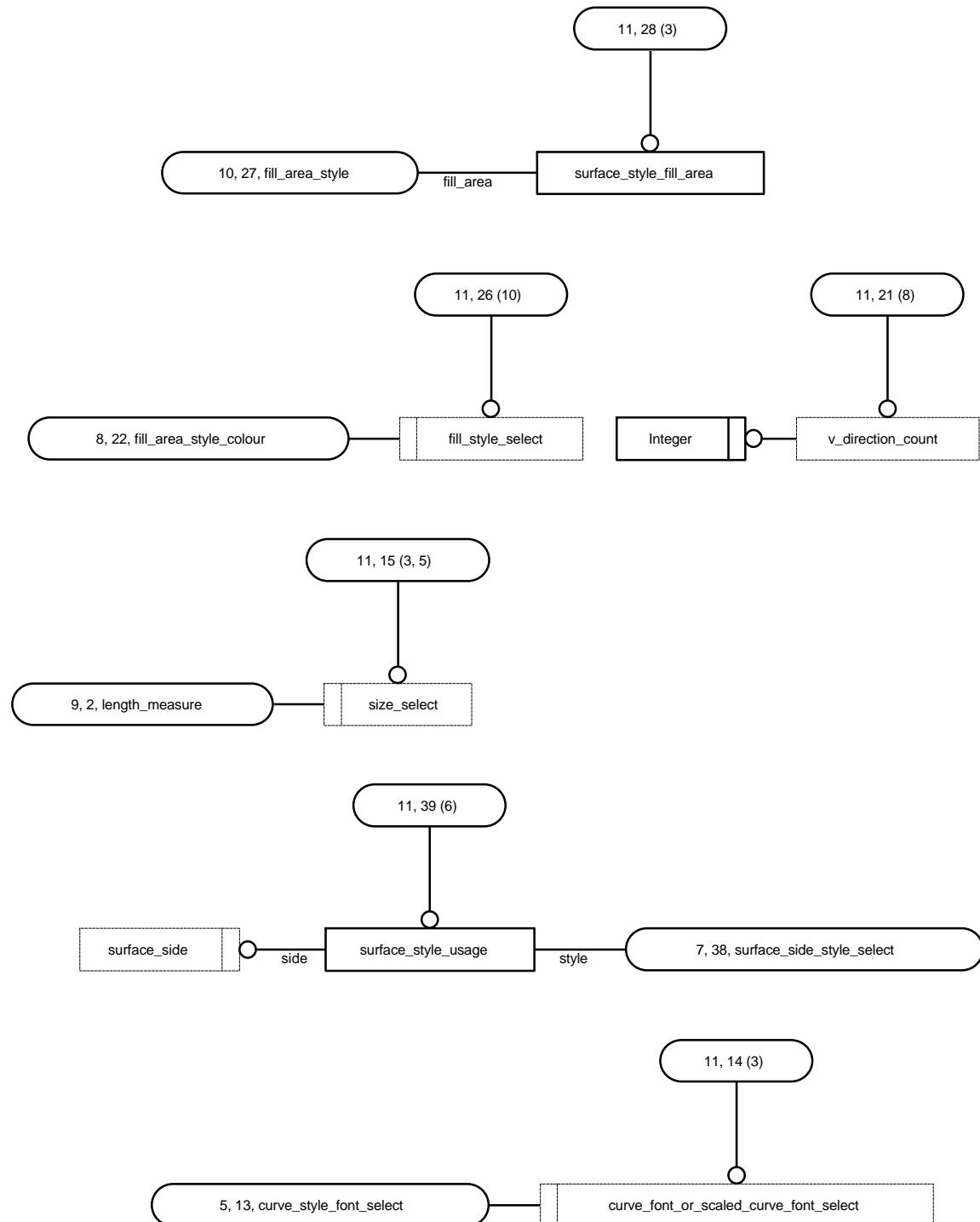


Figure D.11 - MIM EXPRESS-G Diagram 11 of 11

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Annex E

(informative)

AM ARM and MIM EXPRESS

Annex F

(informative)

Application module implementation and usage guide

Annex G

(informative)

Technical Discussions

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